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EXAMINER	
TRINH, THANH TRUC	
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1795	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/523,745	MASCARENHAS ET AL.	
	Examiner	Art Unit	
	THANH-TRUC TRINH	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *2/3/05*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-63* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-63* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2/3/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

1. Claims 1, 3, 7-8, 10, 12-14, 17, 20-22, 27-28, 30-31, 33-38, 43-50, 54-55 and 57 are rejected under 35 U.S.C. 102(e) as being anticipated by Jordan et al. (US Patent Application Publication 20020144725)

Regarding claims 1, 7-8, 10, 13, 20-22, 27-28, 30-31 and 33-35, as seen in Figures 1-4, Jordan et al. teaches a tandem photovoltaic cell (Figure 3) comprising a compliant silicon substrate (combination of 102, 112, 104) including a base of monocrystalline silicon layer (102 in Figure 4) having a first photovoltaic subcell formed therein (pn junction 402 formed by n-type 406 and p-type 408), a conductive perovskite layer (buffer layer 104 as seen in Figure 1), and a SiO_2 layer (or amorphous intermediate layer 112 – See paragraphs 0024-0027) interposed between the conductive perovskite layer (104) and the base silicon layer (102); a second photovoltaic subcell of a group of III-V direct band-gap semiconductor material such as GaAs (pn junction formed by p-type layer 106 and n-type layer 108 as seen in Figure 1, or pn junction of p- GaAs layer 306 and n- GaAs layer of 308 as seen in Figure 3)

positioned above the compliant silicon substrate; a first electrical conductive interconnection layer interposed (such as conductive of p+ 302 in Figure 3) interposed between the compliant substrate (102 and 202 which is the combination of 112 and 104 in Figure 1) and the second subcell (GaAs subcell, 306 and 308); a third photovoltaic subcell formed of a group III-V direct band-gap semiconductor material such as GaInP (318 and 320 as seen in Figure 3); a second electrically conductive interconnection layer (such as layer 314 of p++ GaInP) interposed between the second photovoltaic subcell (306 and 308) and the third photovoltaic subcell (318 and 320); . Since Jordan et al. teaches the second photovoltaic subcell comprising a group III-V direct band-gap semiconductor material such as GaAs, it is the Examiner's position that Jordan et al. also teaches the group III-V direct band-gap semiconductor material of $GaAs_xP_{1-x}$, where x is 1.

Regarding claims 3 and 43, Jordan et al. teach the conductive perovskite layer (or buffer layer 104 as seen in Figure 1) comprises strontium ruthenate. (See paragraph 0026).

Regarding claim 12, Jordan et al. teaches the conductive perovskite layer (or accommodating buffer layer) comprises strontium ruthenate (See paragraph 0026) and the second photovoltaic subcell (106 and 108) is formed of a group III-IV direct band-gap semiconductor material. (See paragraph 0028).

Regarding claims 14 and 36, as seen in Figure 3, Jordan et al. teaches a layer (304) of GaInP interposed between the layer (302) of GaAs and second subcell (306 and 308). It is the Examiner's position that layer (304) of GaInP is the first back surface

reflector layer interposed between the first interconnection layer (302) and the second subcell (GaAs subcell of 306 and 308).

Regarding claim 17, Jordan et al. teaches the conductive perovskite layer (accommodating buffer 104) has a thickness of 5 nm, or 50Å. (See paragraph 0042).

Regarding claims 37-38, as seen in Figure 3, Jordan et al. teaches a second back surface reflector layer (316) interposed between the second electrical conductive interconnection layer (314) and the third photovoltaic subcell (318 and 320), wherein the first and second electrically conductive interconnection layers comprise tunnel junction since each of the electrical conductive interconnection layer is heavily doped.

Regarding claim 44, as seen in Figures 1-4, Jordan et al. teaches a method of forming a multijunction photovoltaic cell, comprising steps of forming n-type (406 in Figure 4) and p-type (408 in Figure 4) regions in a base silicon layer (102 in Figures 1-4) to create a first photovoltaic subcell within the base silicon layer, forming a conductive perovskite layer (buffer layer 104 as seen in Figure 1) above the base silicon layer; forming an oxide layer (or amorphous intermediate layer 112) between the conductive perovskite layer and the base silicon layer; and forming a second photovoltaic subcell of a group III-V direct band-gap semiconductor material above the conductive perovskite. (pn junction formed by p-type of layer 106 and n-type layer 108 as seen in Figure 1, or pn junction of p-type of GaAs layer 306 and n- type of GaAs layer 308 as seen in Figure 3 – See paragraphs 0022-0041)

Regarding claim 45, as seen in Figure 3, Jordan et al. teaches forming a third photovoltaic subcell of a group III-V direct band gap semiconductor material above the second photovoltaic cell. (or pn junction between 318 and 320 of GaInP)

Regarding claim 46, as seen in Figures 1 and 3, Jordan et al. teaches forming a first electrically conductive interconnection layer (302) between the conductive perovskite layer (104 as seen in Figure 1, and is a sub-layer of layer 202 in Figure 3 – See paragraph 0033) and the second photovoltaic subcell (306 and 308).

Regarding claim 47, as seen in Figure 3, Jordan et al. teaches forming a first back surface reflector layer (304) between the first electrical conductive interconnection layer (302) and the second photovoltaic subcell (306 and 308).

Regarding claim 48, as seen in Figures 1-4, Jordan et al. teaches forming a first electrically conductive interconnection layer (302 in Figure 3) between the conductive perovskite layer (104 in Figure 1 and is one sublayer of layer 202 in Figure 3 – See paragraph 0033) and the second photovoltaic subcell (306-308), and a second electrically conductive interconnection layer (314) between the second photovoltaic subcell (306 and 308) and the third photovoltaic subcell (318 and 320). (See paragraph 0051)

Regarding claim 49, as seen in Figure 3, Jordan et al. teaches forming a first back surface reflector layer (304) between the first electrically conductive interconnection layer (302) and the second photovoltaic subcell (306 and 308), forming a second back surface reflector layer (316) between the second electrically conductive interconnection layer(314) and the third photovoltaic subcell (318 and 320).

Regarding claim 50, as seen in Figure 3, Jordan et al. teaches forming a window layer (322) above the third photovoltaic subcell (318 and 320).

Regarding claim 54, Jordan et al. teaches the conductive perovskite layer is formed of strontium ruthenate. (See paragraph 0026)

Regarding claims 55 and 57, Jordan et al teaches the second photovoltaic subcell (306 and 308) is formed of GaAs, or $GaAs_xP_{1-x}$ where x =1. (See paragraphs 0036 or 0051)

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

2. Claims 2, 4-5, 11, 23-25, 39-41 and 51-52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. in view of Li et al. ("A New Thin-Film humidity

and thermal micro-sensor with Al/$SrNb_xTi_{1-x}O_3$/SiO_2/Si structure", Sensors and Actuators, Volume 75, (1999), Pages 70-74).

Jordan et al. teaches a tandem photovoltaic cell and a method of forming the tandem photovoltaic as applied in claims 1, 3, 7-8, 10, 12-14, 17, 20-22, 27-28, 30-31, 33-38, 43-50, 54-55 and 57, wherein the accommodating buffer layer (such as 104 in Figure 1) is formed on a silicon oxide layer (such as 112 in Figure 1) and silicon substrate (such as 102 in Figure 1), wherein the accommodating buffer layer (104) comprises a perovskite material which can be doped (See paragraph 0026), and the second photovoltaic subcell is formed of a group III-V direct band-gap semiconductor material. (See Figure 3, paragraphs 0028 and 0036)

Jordan et al. does not specifically teach the conductive perovskite layer comprises electron doped strontium titanate, $Sr_{1-x}La_xTiO_3$, or $SrTi_{1-x}Nb_xO_3$.

Li et al. teaches forming a conductive perovskite layer on a SiO2 layer and Si substrate, wherein the conductive perovskite layer can be electron doped strontium titanate such as $Sr_{1-x}La_xTiO_3$ and $SrTi_{1-x}Nb_xO_3$. (See “Introduction” of Li et al.)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic cell and the method of Jordan et al. by using electron doped strontium titanate such as $Sr_{1-x}La_xTiO_3$ and $SrTi_{1-x}Nb_xO_3$ as taught by Li et al., because Jordan et al. suggests doping the buffer layer (or perovskite material layer). Because both Jordan et al. and Li et al. are concerned with forming a conductive perovskite layer on a SiO_2 layer and Si substrate, one would have a reasonable expectation of success from the combination.

3. Claims 6, 26, 42 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. in view of Gong et al. ("Oxygen-deficient $SrTiO_{3-x}$, x=0.28, 0.17, and 0.08. Crystal growth, crystal structure, magnetic, and transport properties", Journal of Solid State Chemistry, Volume 90, Issue 2, February 1991, pages 320-330).

Jordan et al. teaches a tandem photovoltaic cell and a method of forming a the tandem photovoltaic cell as applied in claims 1, 3, 7-8, 10, 12-14, 17, 20-22, 27-28, 30-31, 33-38, 43-50, 54-55 and 57, wherein the accommodating buffer layer (such as 104 in Figure 1) comprises strontium titanate which can be doped to form a conducting layer. (See paragraph 0026).

Jordan et al. does not specifically teaches the conductive perovskite layer comprises $SrTiO_{3-\delta}$, where $0<\delta<0.3$.

Gong et al. teaches a conductive perovskite material of SrTiO3-x, where x=0.28, 0.17 and 0.08. (See Abstract)

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic cell and the method of Jordan et al. by using perovskite material of $SrTiO_{3-x}$, where x =0.28, 0.17 and 0.08 as taught by Gong et al., because Gong et al. teaches that a way of making a conducting peroskite material is by having oxygen deficiency in $SrTiO_3$ and Jordan et al. also suggests using conducting perovskite material for the accommodating buffer 104. (See paragraph 0026).

4. Claims 9, 29, 32, 56 and 58-60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. in view of King et al. (US Patent 6340788)

Regarding claims 9, 29, 32, 56 and 58, Jordan et al. teaches a tandem photovoltaic cell as applied in claims 1, 3, 7-8, 10, 12-14, 17, 20-22, 27-28, 30-31, 33-38, 43-50, 54-55 and 57, wherein the second photovoltaic subcell (106 and 108 as seen in Figure 1) or the third photovoltaic subcell (318 and 320 as seen in Figure 3) is formed of a group III-V direct band-gap semiconductor material such as GaAs, GaAsP and GaInP. (See paragraphs 0028, 0036 or 0051).

Jordan et al. does not specifically teach the GaAsP is in form of $GaAs_xP_{1-x}$, or GaInP in form of $Ga_xIn_{1-x}P$.

King et al. teaches a multijunction photovoltaic cells having an active subcell of silicon substrate and other subcells formed on top of the active substrate (See Figure 1), wherein other subcells comprise GaAsP or GaInP (See claims 42-93). King et al. also teaches the composition of GaAsP varied according to $GaAs_xP_{1-x}$, and that of GaInP varied according to $Ga_xIn_{1-x}P$. (See claims 42-93).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic cell of Jordan et al. by adjusting the composition of GaAsP according to formula $GaAs_xP_{1-x}$ and GaInP according to $Ga_xIn_{1-x}P$ as taught by King et al., because King et al. teaches that it would provide subcells that match the current and lattice constant of the substrate. (See Abstract or claim 1).

Regarding claims 59-60, as seen in Figure 3, Jordan et al teaches the second photovoltaic subcell (306 and 308) is formed of GaAs, or $GaAs_xP_{1-x}$ where x =1. (See paragraphs 0036 or 0051)

5. Claims 15-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. in view of King et al. (US Patent 6340788)

Regarding claim 15, Jordan et al. teaches a tandem photovoltaic cell as described in claim 14, wherein the back surface reflector layer (304) comprising GaInP.

Jordan et al. does not teach the specific composition of GaInP, such as in form of $Ga_xIn_{1-x}P$.

King et al. teaches a back surface field layer (under the subcell – See col. 12 lines 31-55) interposed between an interconnection layer (one layer of the tunnel junction) and the second subcell. King et al. also teaches that the back surface field layer comprises the same material as the emitter such as GaInPAs, GaInP, AlGaInP, AlGaPAs, or AlGaAs (See col. 12 lines 51-55), wherein the composition of GaInP is varied according to $Ga_xIn_{1-x}P$ (See claims 42-93).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the photovoltaic cell of Jordan by having the back surface reflector in form of $Ga_xIn_{1-x}P$ as taught by King et al., because Jordan et al. suggests it and King et al. teaches that such back surface reflector would serve as a passivation layer for the subcell. (See col. 2 lines 23-31).

Regarding claim 16, Jordan et al. teaches back surface reflector layer (or layer 304) having a thickness of 70 nm, or 0. 07μm. (See

6. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al.

Jordan et al. teaches a tandem photovoltaic cell as described in claim 17, wherein the SiO_2 layer (or amorphous interface layer 112) has a thickness of 0.5-5 nm, or 5-50 Å. (See paragraph 0027). It would have been obvious to one skilled in the art to select a portion of range, including the claimed range of 5-12 Å, from a broader range disclosed in the prior art because the prior art reference finds that the entire disclosed range has a suitable utility.

7. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. in view of Chiang et al. (US Patent 4133698)

Jordan et al. teaches a tandem photovoltaic cell as described in claim 18.

Jordan et al. does not specifically teach the thickness of between 50 to 150 μm of the base silicon layer.

Chiang et al. teaches using a monocrystalline silicon wafer for a tandem solar cell, wherein the thickness of monocrystalline silicon wafer have a thickness of about 50mm. (See claim 2 of Chiang et al.).

It would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the tandem photovoltaic cell of Jordan et al. by using a

monocrystalline silicon wafer (or the base silicon layer) having a thickness of 50μm as taught by Chiang et al. because Chiang et al. teaches that such thickness would provide a thin solar cell which in turn would maximize the field effect and improve collection efficiency at reduced cost. (See col. 1 lines 55-68 of Chiang et al.)

8. Claims 61-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jordan et al. (US Patent Application Publication 20020144725)

As seen in Figures 1-4, Jordan et al. teaches a tandem photovoltaic cell comprising a compliant substrate (102, 112, 104 as seen in Figure 1) including a base silicon (102 as seen in Figure 4) having a first photovoltaic subcell formed therein (pn junction 402 formed by n-type 406 and p-type 408 as seen in Figure 4), a perovskite layer (104 – See paragraph 0026), and a SiO_2 layer (or amorphous interface layer 112 – See paragraph 0027) interposed between the conductive perovskite layer and the base silicon; a second photovoltaic subcell (pn junction formed by p-type layer 106 and n-type layer 108 as seen in Figure 1, or pn junction of p- GaAs layer 306 and n- GaAs layer of 308 as seen in Figure 3); and electrical contacts (metal layer 404 as seen in Figure 4) operably connected to the photovoltaic cell to conduct current to and from the photovoltaic cell. (See paragraphs 0022-0041). Jordan et al. teaches the perovskite layer is 50Å and comprising strontium titanate (See paragraphs 0026 and 0042). Jordan et al. also teaches the SiO_2 layer having a thickness of 0.5-5 nm, or 5-50 Å. (See paragraph 0027). It would have been obvious to one skilled in the art to select a portion of range, including the claimed range of 5-12 Å, from a broader range disclosed in the

prior art because the prior art reference finds that the entire disclosed range has a suitable utility.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

Claims 1-63 are provisionally rejected on the ground of nonstatutory double patenting over claims 1-77 of copending Application No. 10551598. This is a provisional double patenting rejection since the conflicting claims have not yet been patented.

The subject matter claimed in the instant application is fully disclosed in the referenced copending application and would be covered by any patent granted on that copending application since the referenced copending application and the instant

application are claiming common subject matter, as follows: a photovoltaic cell comprising a compliant substrate including a base silicon layer having a perovskite layer positioned thereon and a layer of silicon oxide interposed between the silicon layer and perovskite layer, a photovoltaic subcell positioned above the compliant silicon substrate, electrical contacts operably connected to the PV cell to conduct current to and from the PV cell.

Furthermore, there is no apparent reason why applicant would be prevented from presenting claims corresponding to those of the instant application in the other copending application. See *In re Schneller*, 397 F.2d 350, 158 USPQ 210 (CCPA 1968). See also MPEP § 804.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to THANH-TRUC TRINH whose telephone number is (571)272-6594. The examiner can normally be reached on 8:30 am - 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on 571-272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TT
4/28/2008

/PATRICK RYAN/
Supervisory Patent Examiner, Art Unit 1795